Delprat of the University of California Medical School and Hospital for testing liver function, or rather its selective permeability according to my interpretation, is the most satisfactory agent of its class and for the purpose. The normal liver removes the dye so rapidly from the blood stream that only traces remain in the blood at the end of sixteen minutes, but the removal is greatly impaired in obstructive jaundice, catarrhal jaundice and in arsphenamin icterus, and in advanced cirrhosis and acute infections of the liver in man, according to Doctors N. N. Epstein, G. D. Delprat and W. J. Kerr of the Department of Medicine, University of California, who have used the dye as a valuable aid in diagnosis and prognosis. In dogs, hepatic permeability of the dye is well known to be diminished after chloroform anesthesia; and also in circulatory disturbances of the liver, in shock and after certain drugs, especially those in the colloidal state such as agar and colloidal silver and arsphenamin in therapeutic doses, which block the liver directly without other causes, as shown by Doctor De Eds and myself. The gall bladder, according to Prof. G. E. Burget of the Department of Physiology, University of Oregon Medical School, is not concerned in the regulation of bile flow.

In the surgery of large vessels a new principle has been discovered by Dr. Emile Holman, professor of surgery, in the Stanford School of Medicine. This requires that under certain circumstances ligation of the main artery to an extremity should be accompanied by ligation of the main vein in order to decrease gangrene formation.

During and following severe muscular exercise lactic acid appears in abnormal quantities in the blood, but the urine does not always show it. Doctors A. W. Hewlett, G. Barnett and H. K. Lewis of the Stanford Department of Medicine seem to have explained this discrepancy by the demonstration of a renal threshold value for lactic acid somewhat as there is for glucose; that is, urine lactic acid can only be demonstrated when there is a considerable excess above the normal. A demonstrable decrease in blood lactic acid occurs during inhalation of air enriched with oxygen, thus diminishing the possible effects of the traditional "fatigue product" in muscle.

Biochemical studies by Prof. C. L. A. Schmidt and associates of the Department of Biochemistry, University of California, indicate that the nondiffusible calcium in blood is bound to the serum proteins; that dyes unite with proteins in stoichiometric proportions thus controverting the older idea of adsorption. The same investigators devised for the first time a liquid medium for, and studied the metabolism of, the hemoflagellate *Leishmania tropica.*

A unique, and modifiable, elevated skeleton maze, permitting direct and detailed observation of the behavioristic intelligence of rats without assistance from extraneous factors, has been devised by Prof. W. R. Miles of the Department of Psychology at Stanford. It will promote greater accuracy in the objective study of various conditions, habituations, drugs, etc., on behavior than has been heretofore possible.

In parasitology, Prof. C. A. Kofoid of the Department of Zoology, University of California, reports the discovery of *Endameba dysenteriae* in bone marrow in Ely's second type of arthritis deformans and in the lymph glands in Hodgkins' disease.

Spider poisoning, especially from the *Black Widow* in California, is more common and serious than has been generally supposed, according to clinical and experimental studies of Dr. Emil Bogen of Los Angeles. Although the bite is rarely fatal, it causes severe illness characterized by an excruciating pain spreading over the entire body, beginning most commonly in the genitalia of men accidentally bitten and becoming especially severe in the abdomen, legs and back, accompanied by nausea, vomiting, constipation and abdominal rigidity lasting twenty-four hours with complete recovery after several days. Treatment is by narcotics; and possibly by a serum which, however, remains to be developed.

Stanford University School of Medicine.

THE TREATMENT OF EMPYEMA *

By E. ERIC LARSON, M. D.
Woodland

DISCUSSION *by Leo Eloesser, M. D., San Francisco; Charles E. Phillips, M. D., Los Angeles; Ben E. Grant, M. D., Los Angeles.*

ONE of the important lessons learned during the World War was the type of operation to be done for empyema as well as the proper time for it to be employed. The old method of thoracotomy, with or without resection of a rib, disregarding pneumothorax or the time of operation, yielded a mortality of 45 per cent in fifty cases. With more conservative treatment, delayed operation and more careful study of patients, the mortality of the next fifty was lowered to 28 per cent. Further modification of treatment by the use of hypochlorite solution in early lesions lowered the mortality to 10 per cent in the next 133.[1] Several surgeons since that time have repeatedly reported mortalities ranging from 2 to 12 per cent.

The early recognition of the condition and its cause are fundamental, for upon this knowledge is based appropriate and efficient treatment, which is further dependent on a clear and definite distinction between acute and chronic empyema. In the acute infections treatment should embody principles directed toward support of the patient's poor general condition and also a prompt and efficient cure. When chronic, treatment in addition should be directed to preventing prolonged morbidity and deformity.

ACUTE EMPYEMA

Acute empyema usually results from adjacent lung inflammation. It may result from general infection or from more distant suppuration. One-half [2] to two-thirds of all pleural suppurations are due to pneumococcus and one-fourth to streptococcus.

* Read before the General Surgery Section of the California Medical Association, at the Fifty-fifth Annual Session, April 28 to May 1, 1926.

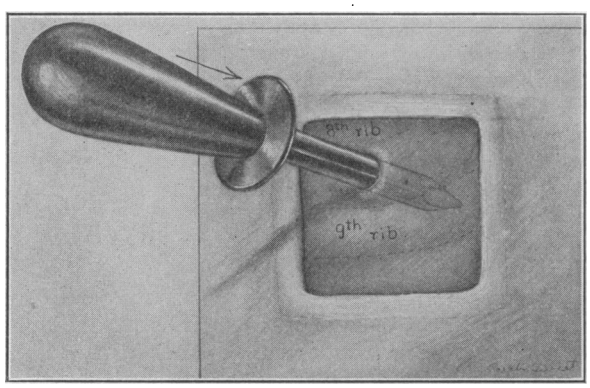

Fig. 1—Insertion of trocar between eighth and ninth ribs. Usually more advantageous points are necessary for drainage.

Typical acute empyema follows lobar pneumonia and is of pneumococcus origin. The fluid is cloudy, thick, appears quite early, is of small quantity, contains an abundance of fibrin and walls off quite readily.

The acute streptococcus empyema usually accompanies bronchopneumonia and is more severe because of the spreading lung inflammation. The pus is thinner, of large quantity, loaded with bacteria, and the tendency to encapsulation into an abscess is markedly delayed.

The first essentials in the diagnosis and treatment should include careful study of the patient, an accurate history and detailed physical findings, supported by x-ray data and finally by aspirations of pus, the character of which is ascertained by direct smear and culture. The condition of the underlying lung as well as that of the opposite side, with particular attention also to the general condition of the patient, should decide the order of procedure.

Simple drainage by needle aspiration may greatly assist an embarrassed circulation and tide the patient along for a few days, allowing the lung condition to subside and the infection to become walled off. Thus a general empyema with the increased problem of cavity obliteration is often averted. Early deaths are not alone due to absorption but rather to the collapse of the air-bearing lung tissue. Therapeutic aspiration, which gives relief, but rarely cures, can be done every twenty-four to thirty-six hours, depending on the condition of the patient. The use of chemical therapeusis can then be considered. Major [3] reports 51.8 per cent cures in twenty-seven cases by the use of gentian violet. He injects 100 cc. of 1 to 1000 solution, gradually increasing the strength to 1:250 in subsequent instillations.

After trying these more simple methods without cure the closed operation, introduced by Bülau [4] in 1891, should be done. We use the army trocar (Fig. 1), following the method of insertion perfected during the war.[5] Under local anesthesia I try to insert an airtight tube just inside the cavity and at a level that will give gravity drainage and still eliminate the possible formation of a valve fistula by shrinkage of the cavity.

The success of the closed operation depends largely on three factors: thorough drainage, prevention of pneumothorax, the use of Dakin's solution.

Thorough drainage maintained by constant suction is the ideal method of evacuation of the cavity, decompression of course being done gradually during the first twenty-four hours when dealing with a large collection of fluid. With this in view I have had constructed an apparatus (Fig. 2), which fulfils all expectations, but examination of the literature reveals that practically a duplicate of this apparatus was used by Van Hook [6] twenty-five years ago. His bottle vacuum is maintained by water pump, while in my apparatus an ordinary bicycle pump is used. A mercury manometer is attached to indicate the degree of vacuum pressure which shows the efficiency of drainage and any possible leakage of air. With this apparatus I have been able to evacuate thoroughly the cavity as well as promote constant negative pressure. Irrigation of the cavity with solutions can also be done by clamping the tubes and disconnecting the apparatus. Moreover, by this method the treatment can be continued at home under the care of an efficient nurse, thus curtailing hospital expense in protracted illness. During the past year a newer contrivance, simpler and less cumbersome, has been introduced by Soresi.[7]

Prevention of pneumothorax is very important, for if it arises and persists, resection of a rib with open drainage is the method of choice. Careful insertion of the tube under local anesthesia can be

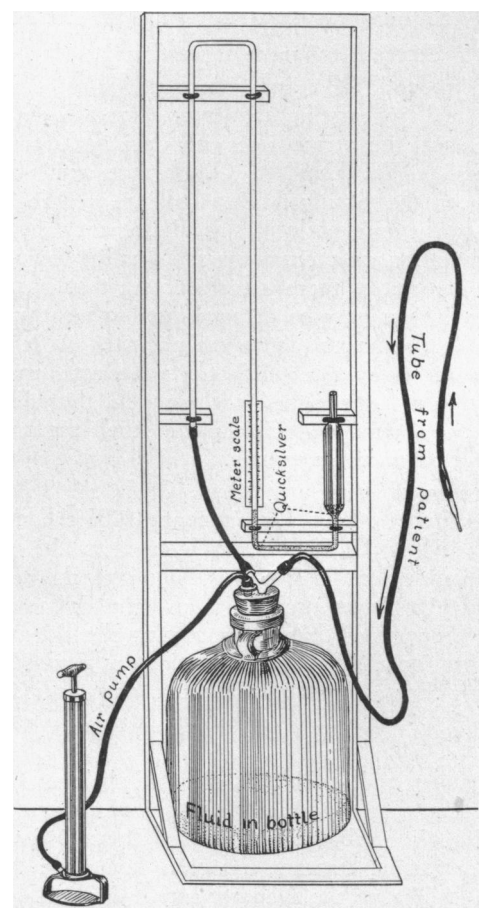

Fig. 2—Suction apparatus, which can be used at home in competent hands to promote constant and complete drainage.

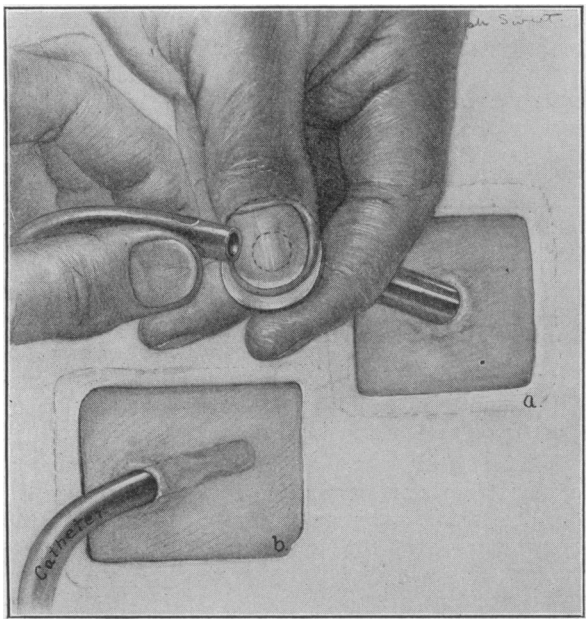

Fig. 3—(a) Trocar removed and catheter inserted through sheath into empyema cavity. (b) Sheath removed, leaving tube in place.

done so as to prevent influx of air (Fig. 3). The catheter should fit tightly into the sheath of the trocar and the tube be carefully clamped.

There are many methods of making the tube airtight within the chest wall. A large rubber dam tied tightly around the tube and glued to the skin is used by many surgeons. Some prefer to pack gauze about the tube and cover well with adhesive tape. The use of metal supports is reported successful. My best results are obtained by using colloidin and cotton packed tightly around the tube on to the skin and supported by strips of adhesive tape.

The third important point is the use of Dakin's solution. Stephens [8] claims decided advantage from its use because it diminishes the fibrous tissue over the lung, allows the lung to expand, removes the fibrin and necrotic tissue, sterilizes the cavity and prevents sacculation and hidden cavities. The solution must be fresh, sterile and contain about one-half per cent available chlorine. The contraindications to Dakin's solution are pleural hemorrhage and pleuro-pulmonary fistulas. My experience supports Stevens'[8] claim that the use of Dakin's solution insures a 90 per cent decrease of the cavity in about forty days.

The position of the tube is important. The usual site of insertion between the eighth and ninth ribs in the axillary line kept several patients from a rapid recovery because, as seen in Fig. 6, there extended a long sinus leading upward to a large cavity. In such patients an opening between the fifth and sixth ribs would have been more advantageous.

After thorough closed drainage has continued for several weeks it may be necessary to unroof a small remaining cavity by rib resection. Care in making the opening of sufficient size to permit coaptation of the skin and pleural surfaces will prevent too rapid closure of the wound (Fig. 5). The cavity should be explored, opening all pockets and removing the loose fibrin and necrotic tissue. If necessary a skin graft can later be used to cover the defect. Bronchial fistulas, which sometimes occur, should be given two or three months for spontaneous closure. Closure of these fistulas can be hastened by chemical irritation, suture, or the actual cautery.

CHRONIC EMPYEMA

Chronic empyema usually means an unrecognized or neglected acute suppuration, an improperly treated or badly operated acute empyema. The time that should elapse before an uncured empyema may be called chronic varies from three to twenty-four weeks. Among surgeons I agree with Hedblom [9] and others, who fix twelve weeks as perhaps the most advisable limit.

In deciding the course to follow it is most important to ascertain the cause for chronicity. Tuberculosis, syphilis, actinomycosis, nondraining pockets, thickened visceral pleura, foreign bodies and osteomyelitis, all must be searched for. The aim should be to re-expand the lung to the chest wall rather than collapsing the thorax against the lung. Lockwood [10] arbitrarily makes the rule that cavities containing over three ounces should be treated by efforts to re-expand the lung, and cavities under three ounces should be treated by unroofing the cavity.

At the Woodland Clinic during the past year I have been using lipiodol injections into the sinuses and cavities for x-ray studies in preparation for operative procedure. The suspension readily enters all pockets and traverses sinuses, producing a dense and unmistakable shadow (Figs. 6 and 7). It is non-irritating to the pleura, and in the detection of pleuro-pulmonary fistulas I believe its use has facilitated greatly in making a thorough exposé of the conditions which should be understood before decision to operate is made.

A chronic, encapsulated empyema with intact thoracic wall should not be hurriedly dealt with. Efforts at reduction of the size of the cavity should be attempted by aspiration and closed drainage. Pickhardt [11] recommends resection of a rib; exploration of the cavity; cleansing of the cavity with a 0.1 per cent iodoform ether solution; insertion of a

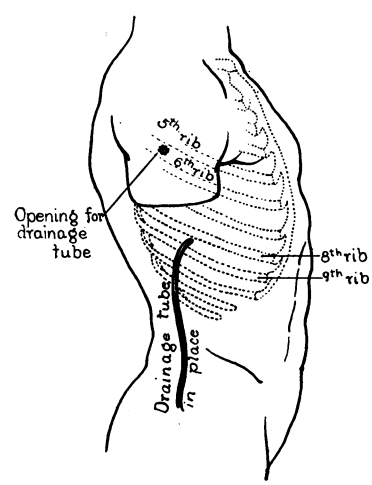

Fig. 4—Usual site for the introduction of closed drainage between eighth and ninth ribs. It is often necessary to drain between fifth and sixth ribs.

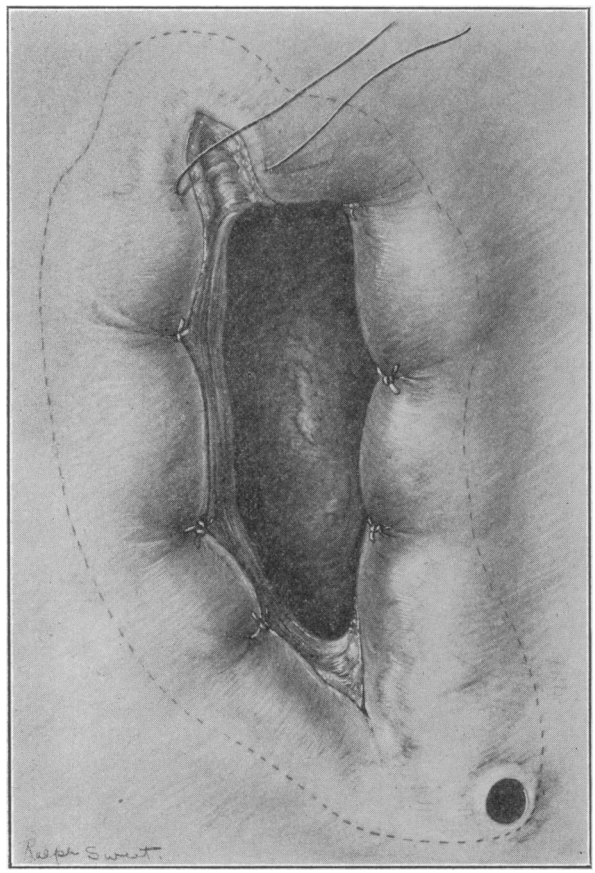

Fig. 5—After resection of rib the skin is approximated to the parietal pleura and the ends of the rib are well covered.

tube for closed drainage below and suturing of the wound in layers, the wound usually healing by primary intention.

Persistent cavities that have been efficiently drained and sterilized for several months should be treated by more radical measures. Thoracoplasties of the Wilms, Schede and Estlander types may be resorted to, but usually are not necessary. Decortication of the lung by expert surgeons, when followed by complete expansion of the collapsed portion, is one of the most satisfactory of operations.

REPORT ON 14 PATIENTS TREATED

During the past year I have treated fourteen patients with empyema at the Woodland Clinic. They were all acute types. The bacteria found were: pneumococcus 7, streptococcus 4, staphylococcus 1, colon 1, combination of proteus and streptococcus 1. There was one death, and that was the proteus-streptococcus infection in which the empyema followed operation for a lung abscess situated in the apex of the right lung. I attribute this death to bad surgical judgment in draining the abscess in a one-stage operation. At the operation I believed that the pleural surfaces were adherent, but an empyema in the right pleural cavity several days later revealed the mistake.

In the management of all patients I was careful to adhere to the principle stated earlier in this paper, that after the diagnosis is made the aim should be treatment by simple measures such as ample and repeated aspiration until the lung condition subsides sufficiently to allow closed drainage. Closed drainage with Dakin's irrigations was instituted in every instance. Also in eleven of the fourteen patients it was necessary to resort to further operative procedure such as rib resection. There is much in the literature regarding complete cure by closed drainage, but I have been unable to prevent a small cavity due to pneumothorax caused by the leakage of air around the tube after five to seven days. I feel that the suction apparatus was a distinct advantage for these few days at least.

Bronchial fistulas occurred in three of my patients. Two closed spontaneously and chemical irritation with silver nitrate was employed to hasten closure of the third.

One patient, 74 years of age, in whom an unrecognized empyema had existed for several weeks had closed drainage, then rib resection. Because of the non-expansion of the underlying lung either a decortication or collapse operation will have to be done in about three months.

A high caloric diet, supplemented in several of my patients by one or more blood transfusions, was instituted because of their sepsis, anemia and weakness. Aside from the operative procedures necessary I consider these two measures of the utmost importance. It is also absolutely essential to get the patient out of bed as early as possible and teach him exercises for thoracic expansion and correction of deformity.

SUMMARY

Fourteen patients with acute empyema and one death, a mortality of 7.14 per cent, forms the basis of this discussion.

The diagnosis of an existing empyema, or the anticipation of this condition, is the most important factor of all.

Acute empyema should be treated by simple measures, such as repeated aspirations, closed drainage, thoracotomy later if necessary.

Chronic empyema should be treated so as to prevent morbidity and deformity. Expanding the lung to the chest wall rather than collapsing the chest wall to the lung should be emphasized.

Employment of a constant suction apparatus to facilitate cavity collapse is of great advantage.

I would emphasize the value of irrigation with Dakin's solution.

The injection of lipiodol into a cavity is a very effective method of ascertaining the complicating factors which promote chronicity.

A high caloric diet is necessary. Blood transfusions are often required. Exercises are important to facilitate lung expansion and secure minimum deformity.

Woodland Clinic.

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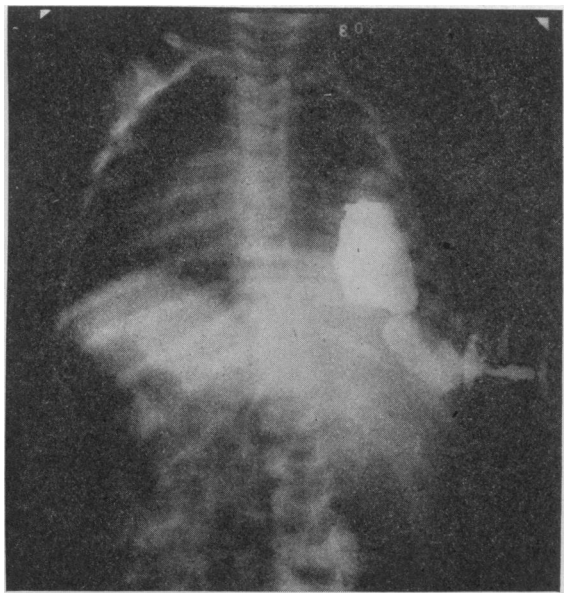

Fig. 6—Case No. 12509. Lipiodol injection. Long fistulous tract caused by improperly situated tube.

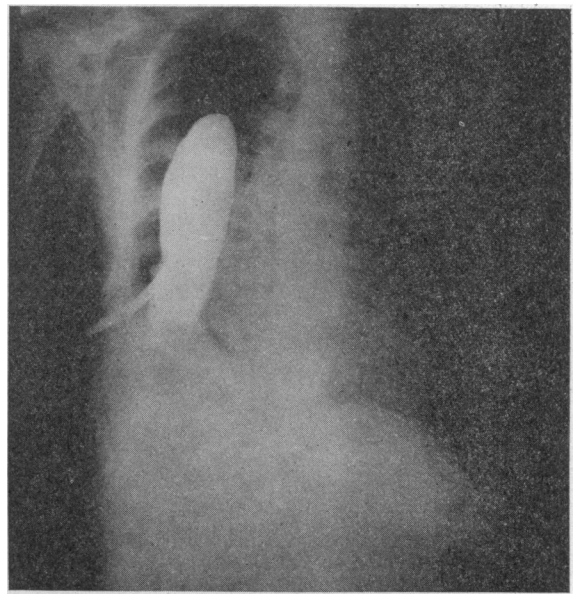

Fig. 7—Case No. 12848. Lipiodol injection. Drainage tube situated correctly.

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DISCUSSION

LEO ELOESSER, M. D. (490 Post Street, San Francisco)—It is consoling to one who has struggled with closed drainage methods to find that Doctor Larson had to supplement the closed method in eleven out of fourteen patients with rib resection. One sees that even in so well conducted a clinic as the Woodland one the trocar stab drainage is anything but easy. It is very satisfactory when it works, but often it does not. It needs constant watching, a trained personnel and skill.

I agree with Larson that exclusion of even the smallest bubble of air, not only at operation, but during the whole subsequent course of treatment, is most important and in the later stages, when the tube begins to loosen in its canal, almost impossible to achieve. Once air enters the chest it cannot be gotten out, and the pyopneumothorax will not heal except after rib resection.

Other unavoidable mishaps—a bit of fibrin stopping the tube, kinks, or the patient's lying on it—make a vacuum drain useless, for we must remember that if a drain doesn't drain it plugs, and plugging a chest with a foreign body is bad. Rib resection is usually easier to handle.

In answering the question whether and when to drain an empyema: If the dyspnea is more than can be accounted for by the quantity of exudate, wait. The dyspnea is probably then not the result of the empyema, but of the underlying pneumonia and the chest is not ready for drainage.

Colonel Keller's method of treating chronic empyema gives surprisingly good results. The decortication operations are difficult and often disappointing. Not every lung should be brought out to the chest wall—the tubercular ones of course not. One can recognize tubercular empyema clinically by the collapse of the lung and its tendency to stay collapsed. In other empyemas, pneumococcic, streptococcic, staphylococcic, the lung comes out toward the chest wall all by itself. It may not quite obliterate the pleural cavity if there is some chronic focus of suppuration, a walled-off abscess or a foreign body in it, but even so it shows a great tendency to.

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CHARLES E. PHILLIPS, M. D. (523 West Sixth Street, Los Angeles)—There is no problem in surgery that calls for the exercise of keener judgment or more prompt action than that required in the treatment of acute empyema.

Epidemics of infectious and contagious diseases vary extremely in degrees of virulence. One characteristic, more or less common to all, is the lessened severity as the epidemic subsides. With the faith of a Crusader, in his remedies, the physician is very prone to attribute the lessened mortality rate to his latest treatment.

Lilienthal in his recent work on thoracic surgery (Vol. I, p. 163), seems to follow the same line of reasoning. He notes the results in three series of cases in army camps, as follows:

1. First series, early operation, eighty-five cases, with a mortality of 61.2 per cent (October 20, 1927, to January 12, 1918).

2. Second series, early aspiration and later operation, ninety-six cases; mortality 15.6 per cent (January 12, 1918, to August 10, 1918).

3. Third series, early aspiration and late operation, ninety-four cases; mortality 9.5 per cent (October 18, 1918, to February 14, 1919).

He apparently attributes the improvement in the mortality rate to the treatment employed. A fair comparison might be drawn between the influenzal epidemic of 1918 and that of the succeeding years. The high mortality

in the former was not lowered in the subsequent years so much by the treatment employed as it was by the lessened virulence of the infection.

Treatment—We choose a line of treatment on the following:

1. Rationale. It should be logical.

2. Simplicity. The simpler the method the less chance of error.

3. Results. The acid test of all should be the results accomplished.

Considering the problem under these three heads, we arrive at the following: Normally the negative pressure is slight. Opening the chest in a normal individual gives rise to few symptoms outside of an increase in the respiratory rate. In the patients suffering from a pneumonitis with the bulk of the lung greatly increased by swelling, and by the products of inflammation in addition to the purulent accumulation within the pleural cavity, the negative pressure within the chest becomes a positive one. Opening such a chest should give rise to almost no shock. It puts the affected lung to rest. It checks absorption. It can always be performed quickly, easily and painlessly by the employment of a local or regional anesthetic.

We come to the comparison of results. I would like to quote our results obtained on the Canal Zone during the construction of the canal:

1910—13 cases with 1 death.

1911—13 cases with 1 death.

1912—15 cases with 2 deaths.

1913—14 cases with 2 deaths.

A total of fifty-five cases with six deaths, as published in the Annual Reports of the Isthmian Canal Commission. When we take into consideration that many of these were suffering from intercurrent diseases, malaria, dysentery, etc., and practically all with varying grades of anemia; they were treated in wards where careful nursing and individual care was practically impossible; and all were treated by the open method and without the advantage of Dakin's solution, these results compare quite favorably with the best that can be shown by the closed method of treatment.

My conclusions are:

1. The mortality rate varies directly as the virulence of the infection with either method of treatment.

2. Operative interference must not tax the strength of the patient.

3. Carrel Dakin treatment offers the greatest advance in the treatment of a suppurative pleuritis.

4. The relief of pressure from purulent accumulations and rest to the sick lung is of greatest importance.

5. The early relief of pressure favors rapid expansion and complete recovery.

Closed method of treatment is indicated: (a) In desperately ill cases with small accumulations of fluid. (b) in neglected cases with great accumulation of fluid. (c) Where the pleuritis is due to, or complicated by, tuberculosis.

The treatment of choice is the early open thorocostomy and Dakin treatment of the cavity.

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BEN E. GRANT, M. D. (1012 Brockman Building, Los Angeles)—The variance of mortality statistics usually ascribed to this or that method of treatment of empyema is no doubt due to the virulency of the various infecting organisms. This will also explain the heated discussions for and against early tapping and the merits of thoracentesis and rib resection. The mortality lists of well-equipped hospitals usually vary according to the stage and type of infection with which each patient is afflicted. The deciding factor in determining the procedure should be the condition of the patient.

The margin of safety in rib resection in the early acute cases is very narrow, because of accompanying shocks. Careful aspiration with the trocar seems the best method of procedure. In addition, at this time autogenous vaccine might be used to build up more resistance and further prepare the patient for further investigation.

In the milder types with less virulence repeated tappings may be all that is required; however, later, if pus persists, a thoracotomy is the best line of procedure.

The resulting dangers from pneumothorax are much more acute in the early stage, and for this reason watchful waiting, with repeated aspirations, is, to my mind, the safest way to care for these cases.

Irrigations with Dakin's solution after surgery can be considered where the pus is very thick and drainage blocked. It is also the best stimulant for healing, although some care should be exercised to avoid any irritation to the inflamed surfaces.

Results depend upon the existing complications and individual resistance.

Doctor Larson is to be congratulated on the low mortality rate of this group. It certainly shows what can be done in a well-organized clinic. His percentage of final thoracotomies is in harmony with reports from other well-recognized clinics.

CERVICITIS, WITH SPECIAL REFERENCE TO ITS TREATMENT

By WILLIAM E. HUNTER, M. D.
Salt Lake City, Utah

DISCUSSION *by Fred R. Fairchild, M. D., Woodland, California; J. U. Giesy, M. D., Salt Lake City, Utah.*

CERVICITIS is often spoken of as endocervicitis, erosion, pseudoerosion, ectropian, eversion, and sometimes ulceration of the cervix. Such terms are misleading, for they give the impression that the inflammatory lesion is limited to the lining of the cervix, particularly the exposed cervical mucosa. This is incorrect, for the pathological changes penetrate deeply into the musculofibrous tissue of the cervix and outward onto the squamous epithelium that covers the exposed cervix. In severe cases the inflammatory reaction extends into the parametrium and upward by lymphatic extension upon the tubes and ovaries. The lesion is not one of erosion or ulceration but one of cell proliferation. The eversion is the result of cell growth with scar-tissue formation beneath which causes the cervical endothelium to roll out or evert.

HOW THE CAUSES ACT ON CERVICAL TISSUE

Cervicitis is always the result of bacterial invasion of the racemose glands of the cervix following trauma from childbirth or by the invasion of the gonococcus which has the power of burying itself between the cells of normal mucous tissue. In a few patients it follows a developmental defect which exposes the cervical glandular tissue to the acid secretion of the vagina (congenital pseudoerosion). Normally the upper vagina and cervix are free from pathogenic organisms. The acid secretions and the pavement epithelium of the vagina present an effective barrier against bacterial extension upward. Curtis has shown that the body of the uterus is practically immune against bacterial invasion, but that the mucus-secreting epithelium of the cervix with its numerous glands is susceptible to infection and will harbor germs for years. Following injury to the cervix, the columnar epithelium pushes outward and replaces the squamous epithelium beyond the external os. This new epithelium has the power